trophy in others. Thus, the somatic sensory is represented only in the V and X nerves and the visceral sensory in the typical branchiomeric nerves, X, IX, VII.

Now when in course of vertebrate evolution specialized sense organs appear in addition to the two primary components, their nerves and intra-cranial centers will appear sporadically, depending upon the distribution of the specialized sense organs in question. These nerves will in general follow the courses of the previously existing somatic or visceral nerve trunks wherever possible, hence the formation of complex nerve trunks containing several of the components. Each of these cenogenetic systems of sense organs, like the palingenetic systems, tends to be related to a single intracranial center. At present we may enumerate the following such systems:

1. Taste buds related to the fasciculus communis (f. solitarius) and its associated nuclei, the chief vagus nucleus (lobus vagi of fishes).

2. Terminal buds of the outer skin; terminal relations as in the last case, plus in some fishes the lobus facialis.

3. Lateral line organs, or neuromasts, related to the tuberculum acusticum and cerebellum, plus in some fishes the 'lobus lineæ lateralis.'

4. Ear; central connection as in the last case.

5. Eye; related to the mesencephalon.

6. Nose; related to the primary prosencephalon.

7. Pineal organ; related to the diencephalon?

Diagrams were exhibited illustrating the actual relations of these components as determined by reconstruction from serial sections in the bony fish, *Menidia;* and emphasis was laid upon the necessity of taking these qualitative differences in the nerves into account before trying to work out their metamerism.

The Maxillary and Mandibular Breathing Valves of Teleost Fishes. ULRIC DAHLGREN.

THE discovery of a pair of membranous valves placed just inside of the teeth and working automatically to prevent water from leaving by the mouth while they permit its free entrance, has enabled the act of breathing in fishes to be clearly described. These valves complete the pump-like structure of the oral cavity, the other pair, or posterior valves, being the branchiostegal membranes.

In breathing, but two muscular forces must be applied, one to expand the oral cavity by moving the opercular frames outward and another to contract the oral cavity by moving them inward; when expanding, water comes in through the mouth, being prevented from entering through the gill clefts by the branchiostegal membranes, which act *automatically* and independently of and contrary to the opercular frames to which they are attached; when contracting, water is forced out of the gill clefts, but is prevented from leaving through the mouth by the valves in question, which act *automatically.* While breathing, it is true, the fish opens and shuts its mouth somewhat, but this is due not to its effort to prevent a regurgitation of the respiratory stream, but to the relation of its mandible to the opercular frames.

When the valves are cut, the fish is compelled to use muscular force to prevent regurgitation.

On the Early Development of the Catfish (Noturus). F. B. SUMNER.

1. No horizontal cleavage takes place till the 64-cell stage or after, and, when it occurs, does not result in a definite two-layered condition of whole germ-disc.

2. The blastomeres resulting from the early cleavages retain their continuity with the protoplasmic network of the yolk. No sharp line of separation, such as Sobotta,

Behrens and Samassa describe for the Salmonidæ, exists in the egg of the catfish.

3. After horizontal cleavage occurs, the lower cells resulting from this division retain their continuity with the yolk, as has been described by Kowalewski, Hoffman and Berent (Teleosts) and Dean (Ganoids). These partial cells (merocytes) continue to divide by mitosis both horizontally and vertically. In the former case, the upper of the products of division is added to the germ-disc. This process of supplementary cleavage continues until a late segmentation stage, cells being added to the whole lower surface of the germ-disc.

4. The periblast arises from the residual portion of the merocytes after supplementary cleavage has ceased, being thicker under the margin of the germ-disc, but present elsewhere from the beginning.

5. The periblast is trophic in its function, playing only an indirect part in cell-formation. Normal mitosis soon gives place to abnormal and this in turn to amitosis. Transitional forms occur.

6. The subgerminal space (segmentation cavity) does not appear till about time of origin of germ-ring. At close of segmentation, yolk and blastodisc are in close contact in well-preserved specimens, although no longer continuous with one another. Clefts which early appear between blastomeres or below them are probably artifacts. If not, they disappear later.

7. The germ-ring (mesentoderm) arises primarily as a marginal ingrowth due to cell-proliferation from germ-wall (Randwulst). The germ-ring also receives abundant additions from the overlying primary germ-layer, even at considerable distance from the periphery. (See Reinhard, Arch. f. Mikr. Anat., 1898.)

8. The whole germ-ring, extra-embryonic as well as embryonic, contains both entodermal and mesodermal elements (*contra* H. V. Wilson and Samassa).

9. Kupffer's vesicle arises, as in the Salmonidæ, as a cavity completely shut in by cells from the first. It is at first much compressed horizontally and distinctly bilobed. In embryos with a short tail it is still to be seen near tip of the latter, strongly suggesting neurenteric canal of Selachii. A second vesicle, situated in yolk under the posterior end of the embryo, appears slightly in advance of Kupffer's vesicle and reaches a size exceeding the latter. It is bounded by periblast and perhaps contains more fluid yolk for service of the growing end of embryo.

Respiratory and Breeding Habits of Polypterus Bichir. N. R. Harrington.

On physiological grounds *Polypterus* is as fully qualified for a 'lung-fish' as are any of the Dipnoans; it has also striking resemblances in its circulatory and respiratory system to the *Urodela*. These points were demonstrated by means of mounted preparations, the injecting of which had been done in the field principally by Dr. Reid Hunt.

Beside the blood-supply to the lungs (which is from the last branchial arch), the dissections showed the very large *glottis*, or ductus pneumaticus, by which the lungs open ventrally from the œsophagus. Unlike the swimming-bladder of fishes in another respect, both the lungs are entirely invested with peritoneum, although one of them, the right, does occupy the normal position for an air-bladder, viz., between the aorta and kidneys, on the one hand, and the alimentary canal, on the other. The mesentery, however, in which the left lobe should be suspended, has almost entirely degenerated, and this somewhat smaller lobe lies entirely free in the body-cavity.

It was pointed out that, while the strongest disproof of the Dipnoan ancestry of the Amphibia lies in the paleontological evidence which indicates that they are a parallel line, the same conclusion may be in-